Biological Treatment of Mixed Wastes: A Safer Alternative to Incineration

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RESEARCH OBJECTIVES

The objective of this research was to develop a biological treatment process that could serve as an alternative to incineration for the treatment of mixed wastes. Mixed wastes are wastes that contain both radioactive materials and hazardous chemicals. Radioactive wastes are regulated under the Atomic Energy Act and are most safely disposed of in a secure landfill where the radioactivity is excluded from the biosphere. Hazardous wastes are regulated under the Resource Conservation and Recovery Act (RCRA) and are prohibited from disposal in landfills. Hazardous waste regulations take priority, and mixed wastes are typically incinerated. During incineration, radioactivity is released directly to the biosphere.

The advantage of biological treatment is that radioactivity can be contained during treatment of the hazardous waste component. Once the hazardous waste component is treated biologically, the waste is no longer regulated under RCRA, and the radioactivity can be kept from the biosphere.

APPROACH

To meet the objective of a completely contained treatment process, we developed a "Drip-Feed Bioreactor" (Figure 1). Unlike conventional biological treatment systems, in the drip-feed system the waste stream flows into the reactor, but no waste flows out. In the reactor, the waste is contacted with specially prepared bacterial cultures that completely destroy the hazardous waste to carbon dioxide and water. The radioactive waste is not treated by the bacteria, but is contained in the reactor for recovery and safe disposal.

ACCOMPLISHMENTS

The Drip-Feed Bioreactor was tested for the treatment of a mixed waste containing acetonitrile (the hazardous waste) and tritium (the radioactive waste). This type of waste is generated during biomedical research at universities and hospitals throughout the nation. Under the RCRA regulations, the acetonitrile must be reduced to below 1.0 mg/L before the waste is no longer considered hazardous. A surrogate (nonradioactive) waste was tested that contained acetonitrile at a concentration of approximately 10% by volume. Results of this trial are as follows: influent acetonitrile concentration, 88,000 mg/L; final acetonitrile concentration, less than 0.1 mg/L.

SIGNIFICANCE OF FINDINGS

This study demonstrated that the Drip-Feed Bioreactor could be used to treat mixed wastes containing acetonitrile to concentrations below 1.0 mg/L, the land disposal restriction for this compound. This study showed that mixed wastes can be treated without releasing radioactivity and that incineration should not be considered the only alternative for treatment of mixed wastes.

This study represents the first time that a highly concentrated hazardous waste has successfully been treated biologically without excessive dilution. The robust nature of the Drip-Feed Bioreactor suggests that this reactor could be used to treat other concentrated hazardous or toxic wastes, including scintillation cocktail and chemical agents.

RELATED PUBLICATION

Chang, L.-Y., A. Proctor, and W.T. Stringfellow, Kinetic parameters for the biological treatment of mixed wastes containing acetonitrile and methanol. Berkeley Lab Formal Report LBID-2433, 2002.

ACKNOWLEDGMENTS

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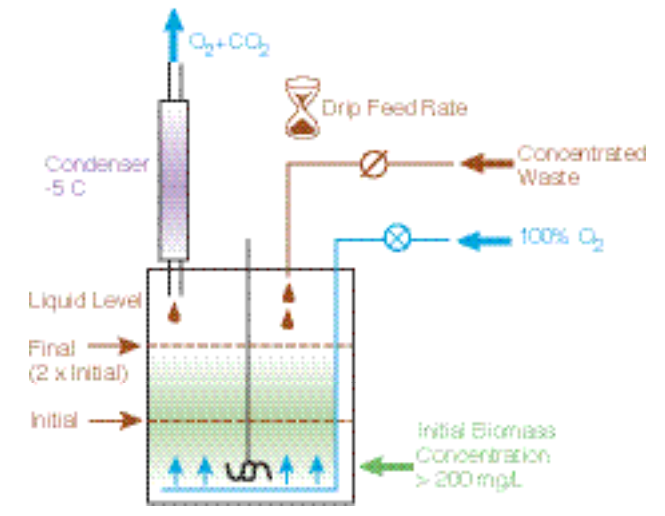

Figure 1. Drip-feed bioreactor schematic